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Discovery of a Highly Specialized Cave Trechine (Coleoptera, Trechinae) in Southeast China

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Abstract An extraordinary trechine beetle is described from a limestone cave in Southeast China under the name of *Sinaphaenops mirabilissimus* gen. et sp. nov. It seems to have a relationship, though remote, to the members of the *Erebotrechus* series, but is readily recognized on its unique body form and peculiar chaetotaxy. This is the first record of an eyeless trechine beetle from Mainland China.

Anophthalmic trechine beetles are known from various parts of the world. They are especially abundant in the temperate zone of the Northern Hemisphere, and in East Asia many genera and species have been described from Japan, Korea and Taiwan. However, none of such eyeless species have so far been recorded from Mainland China in spite of existence of vast calcareous areas and innumerable limestone caves. Many caves have been examined by experienced biologists in the Provinces of Hebei, Shandong, Jiangsu, Zhejiang, Guangdong, Guangxi and Guizhou, but the results obtained were almost always discouraging. This did not appear to mean that the caves examined were naturally devoid of the fauna, but might have been caused by artificial destruction of habitats, above all by tight pavement of cave floors. It was, therefore, hoped to locate such caves as had not been tampered with and to examine their faunas.

At last at the beginning of this year, the junior author came across an eyeless beetle while invesigating limestone caves at the southeastern part of Guizhou near the Guangxi border. It looked like a leptodiroid bathysciine at first sight, but a close examination proved that in reality it was a trechine beetle showing the highest morphological modification adaptive to subterranean existence. Though the material now at hand is not yet satisfactory, the authors are going to introduce this remarkable finding into science in view of its utmost importance.

The abbreviations used in this paper are as follows: HW – greatest width of head; PW – greatest width of prothorax; PNW – greatest width of pronotum; PL – length of pronotum, measured along the mid-line; PA – approximate width of pronotal apex;

PB – approximate width of pronotal base; EW – greatest width of elytra; EL – greatest length of elytra.

Before going into further details, the authors wish to express their heartfelt thanks to Professor YUAN Daoxian and Mr. CAO Jianhua of the Institute of Karst Geology, Guilin, Mr. XU Tingyu of Mao-lan, and Professor Yoshiaki NISHIKAWA of Ohtemon-Gakuin University, Osaka, for their kind help and encouragement in pursuing bio-speological investigations in southern China.

Genus ***Sinaphaenops*** S. UÉNO et F. WANG, nov.

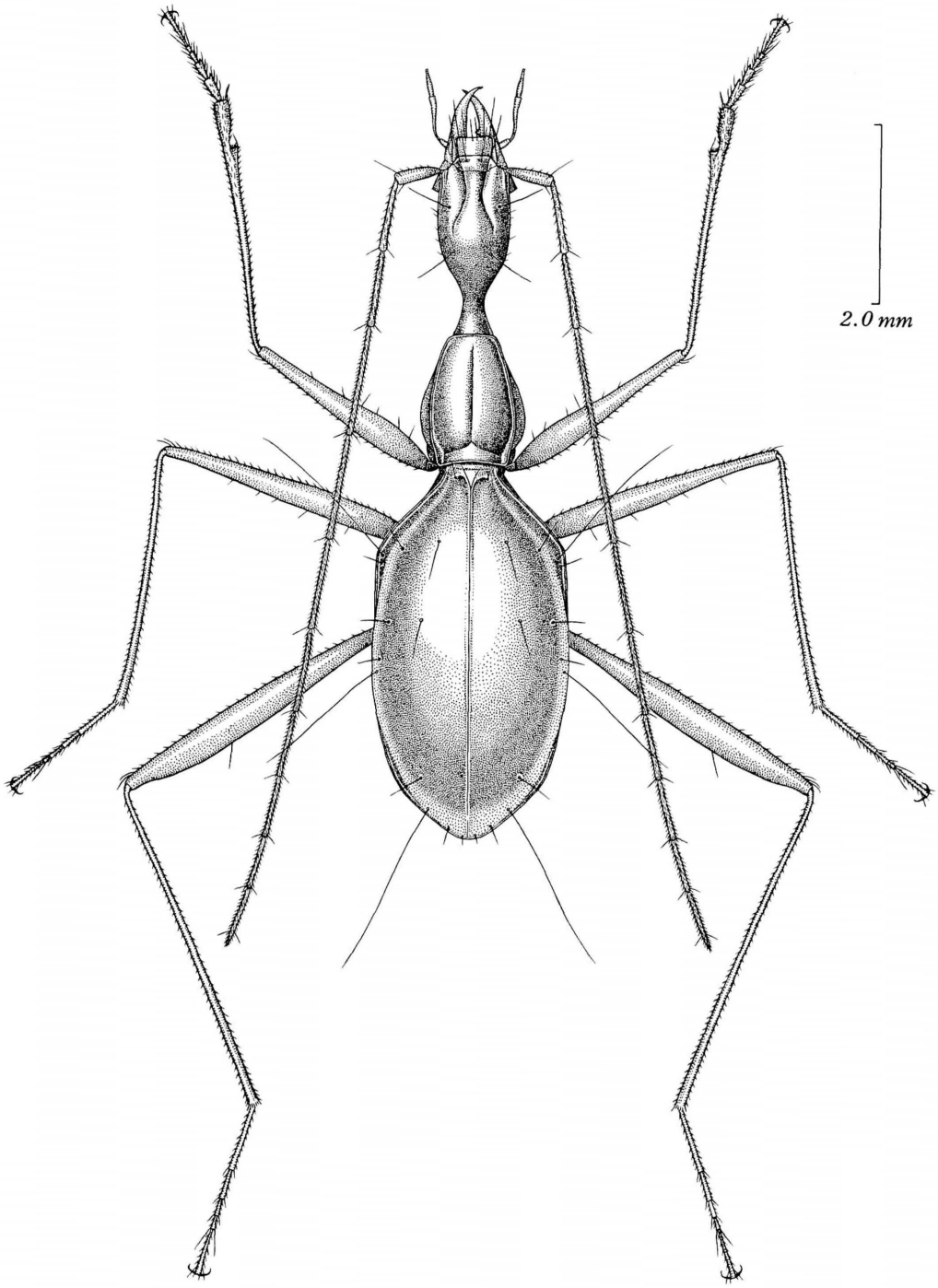
Type species: *Sinaphaenops mirabilissimus* S. UÉNO et F. WANG, sp. nov.

An aphaenopsoid genus showing the highest morphological modification adaptive to subterranean existence. Probably related, though remotely, to the members of the *Erebotrechus* series, but distinguished at first sight from them, and also from all the other known genera of the subfamily, by the peculiar conformation of head, complete absence of marginal setae on pronotum, and the unique arrangement of marginal umbilicate pores on elytra.

Habitus aphaenopsoid or rather leptodiroid, with very long head and prothorax and hemi-ovoidally convex elytra; surface completely glabrous on dorsum but sparsely pubescent on abdominal sternites; all appendages extremely long and slender; inner wings absent. Colour reddish brown, translucent and shiny.

Head very long and narrow, much longer than prothorax, with very slender neck constriction shaped like a long hourglass; frontal furrows incomplete, fairly deep and almost straight in front, sinuate behind, and obsolete before the level of posterior supraorbital seta; eyes completely vanished, without trace of preocular line; genae gradually convergent behind, each provided with several fairly long hairs at the lower part; two pair of supraorbital setae present on lines convergent behind, the posterior pair very widely distant from the anterior; labrum transverse, very slightly emarginate at apex. Mandibles very slender, tridentate, feebly arcuate, and acute at the apices. Labium completely fused though trace of labial suture is perceptible by transparency; mentum provided with a porrect tooth in apical emargination, which is either simple or very slightly notched at the tip; submentum sexsetose; ligula semicircularly produced, octosetose; paraglossae moderately arcuate, extending much beyond ligula; labial palpus long and very slender, penultimate segment only slightly dilated at the apex and quadrisetose, apical one about three-fourths as long as the penultimate, subcylindrical though slightly dilated at proximal two-fifths. Maxillae very slender, only a little shorter than mandibles; lacinia gently arcuate and sparsely provided with thin recurved spines and hairs on the inner margin; maxillary palpus very long and slender, completely glabrous, penultimate segment subcylindrical in basal half and then gradually dilated towards the apex, apical segment about seven-eighths as long

Fig. 1. *Sinaphaenops mirabilissimus* S. UÉNO et F. WANG, gen. et sp. nov., ♂, from Tian-zhong Dong Cave in Southeast China.


2.0 mm

as the penultimate, slightly dilated at basal two-fifths, and subcylindrical in apical third. Antennae exceedingly long and slender, extending much beyond the apices of elytra, scape the shortest, though thickest, of all the segments, followed by the penultimate, which is obviously shorter than segment 2 and slightly shorter than the terminal, segment 4 the longest.

Prothorax elongate, much longer than wide though wider than head, widest at about basal two-fifths and more gradually narrowed towards apex than towards base, which is much wider than the former; pronotal sides finely but entirely bordered, gently arcuate only near the widest part and hardly sinuate before hind angles, the fine borders continuing onto apex and base; both front and hind angles rounded; marginal setae totally absent; dorsum convex, with a distinct median line which reaches neither apex nor base; basal transverse impression sulciform and continuous, though arcuate on each side and forming an obtuse re-entrant angle at the middle; basal foveae small and narrow, extending anteriorly along the side borders; no postangular carinae. Propleura remarkably tumid and widely visible from above outside the side borders. Scutellum small though distinct.

Elytra ovate, much wider than prothorax, very strongly convex, and fused together, with narrowly peduncled bases, oblique prehumeral borders, distinct shoulders, and narrowly rounded apices; basal area foveolate between suture and basal setiferous pore; side borders complete from basal peduncle to apex, but invisible from above at the middle part due to lateral expansion of dorsum; striae and strioles totally vanished; two setiferous dorsal pores present on the site of stria 3; preapical pore absent; two apical pores present, the smaller posterior one adjoining the border at the apical corner, and the larger anterior one near the side border; marginal series of umbilicate pores not aggregated, the first pore widely distant from marginal gutter and lying just in front of the level of the second pore, the second and third pores adjoining marginal gutter and very near to each other, the fourth pore widely distant from the third and also from marginal gutter, and nearer to the fifth pore than to the third, the fifth and sixth pores also distant from marginal gutter, close to each other and lying at the two ends of a short groove, the seventh and eighth pores not unusually spaced, both not adjoining marginal gutter, and the former being widely removed from it.

Ventral surface smooth except for abdominal sternites; prosternum sparsely provided with setae of various lengths along the median line; prosternal process curved ventrad and remarkably dilated between conical procoxae; mesosternum narrowly peduncled anteriad, with the process angulately dilated between conical mesocoxae; metasternum short and transverse, with the process long, fairly broad and finely bordered. Abdominal sternites, inclusive of the anal one in ♂, each provided with two pair of setae along the posterior margin, and sparesely pubescent except for lateral parts.

Legs exceedingly long and very slender; pro- and mesocoxae large and conically protruding; pro- and mesotrochanters elongate; protibiae straight, moderately dilated in apical third and with toilet organ at about apical fifth, entirely pubescent, and not

externally grooved; tarsi thin though not exceedingly long, segment 1 much longer than segments 2–4 together in mesotarsus, about as long as the latter in metatarsus, segment 4 with a long hyaline ventral apophysis in pro- and mesotarsi; in ♂, protarsal segments 1 and 2 elongate though moderately dilated, the former being about twice as long as wide, each narrowly spurred inwards at the apex and furnished beneath with sexual adhesive appendages.

Male genitalia very small; aedeagus short, depressed, widely open on dorsum, and surmounted with large membraneous sac, with elongate basal part widely open ventrad and rather short apical lobe obtusely tuberculate at the tip; sagittal aileron present; inner sac scaly though the scales are hardly sclerotized, and armed with a large anisotopic copulatory piece, which is higher than lateral walls of aedeagus; styles not large, each bisetose at the apex.

Notes. Because of the extreme modification of its external morphology, it is difficult to determine with confidence the true affinity of this strange genus. It looks like a member of the *Aphaenops* series in many respects (cf. JEANNEL, 1928, pp. 24–25, 140–251; CASALE & LANEYRIE, 1982, pp. 24–26, 157–175), and has several important features, including the peculiar shape of prothorax, in common with *Sardaphaenops* CERRUTI et HENROT (1956, p. 121) from Sardinia, one of the most specialized aphaenopsoid trechines in the world. However, the resemblance seems to have been brought about through convergence, merely showing that the two genera are at the ultimate stage of subterranean evolution of trechine beetles. *Sinaphaenops* has tridentate mandibles, which are not found in any genera belonging to the *Aphaenops* series.

Sinaphaenops differs from the relatives of *Aphaenops* also in evolutionary trend. It shows a leptodiroid modification of hind body, which is hemi-ovoid and typically physogastric, whereas none of the latter genera show indication of this type of specialization. In this respect, *Sinaphaenops* resembles *Gulaphaenops* S. UÉNO (1987, p. 3) from the Korean Peninsula, but the latter is related to the genus *Suzuka* of the *Trechoblemus* series as was already pointed out by the senior author (UÉNO, 1987, p. 2, 1989, pp. 20–21) and does not seem to belong to the same phyletic group with the former.

The most probable candidates that may have some relationship with *Sinaphaenops* seem to the authors to be the members of the *Erebotrechus* series from New Zealand. This genus-group has so far been known from two aphaenopsoid species, *Erebotrechus infernus* BRITTON (1964, p. 625, fig. 1) and "*Duvaliomimus*" *lamberti* BRITTON (1960, p. 34, fig. 1), the latter of which actually belongs to a new genus related to *Erebotrechus*.[1] Both have tridentate mandibles, and though not comparable with *Sinaphaenops*, they show a trend of undergoing leptodiroid modification. This is particularly apparent in "*Duvliomimus*" *lamberti*, whose fore-body is very narrow and whose elytra are strongly convex. Unfortunately, BRITTON's descriptions and illustrations of these aphaenopsoid trechines are not only inadequate but misleading in certain critical points. For instance, the humeral set of marginal umbilicate pores on elytra is not

1) It is unfortunate that the authors cannot cite the new generic name, which is supposed to be given by Mr. J. I. TOWNSEND together with full redescriptions of these remarkable trechine beetles.

aggregated in both the species, contrary to BRITTON's account of "setiferous punctures of the elytra as in *Duvaliomimus*."

Needless to say, there is a very wide geographical gap between Southeast China and South Island of New Zealand, so that relationship between *Sinaphaenops* and the *Erebotrechus* group may not be direct. In fact, the latter is different from the former in the number of submental setae (eight instead of six), in the chaetotaxy of pronotum and elytra, in the structure of protibiae, and so on. This may mean that *Sinaphaenops* forms its own group remotely related to the *Erebotrechus* series. However, a similar faunal relationship between East Asia and New Zealand is already known in the Trechinae, that is, Japanese *Thalassoduvalius* is related to New Zealand *Duvaliomimus* (cf. UÉNO, 1956, 1978), and the common ancestor of these genera is considered to have originated in the Asian Continent, most probably somewhere in Mainland China. Perhaps, the ancestral beetle that gave rise to *Sinaphaenops* and the *Erebotrechus* series also originated in the Asian Continent, but its descendants became so much differentiated through long isolation under the earth that evidences to corroborate their direct relationship may have become more and more obscured (cf. UÉNO, 1982).

Sinaphaenops mirabilissimus S. UÉNO et F. WANG, sp. nov.

(Figs. 1–3)

Length: 7.60–8.30 mm (from apical margin of clypeus to apices of elytra).

A large species of peculiarly modified facies, with very long fore-body, hemi-ovoidally convex elytra, and exceedingly long appendages. Colour reddish brown, shiny except for elytra which are dull shining, with lighter apical halves of antennae; palpi pale yellowish brown.

Head very long and narrow, barely two-fifths as wide as long, widest at about apical third and about four-fifths as high as wide at that part, subparallel-sided in front, gradually narrowed behind into very narrow, cylindrical neck constriction, which is only one-third as wide as the widest part, and then dilated again towards prothoracic articulation, which is fully 1.5 times as wide as the narrowest part; dorsum convex, especially in an area before the middle surrounded by the posterior parts of frontal furrows; frons longitudinally convex, supraorbital areas less so; frontal furrows almost straight and gradually convergent posteriad in the anterior parts, externally arcuate just before the level of anterior supraorbital pore, and then roundly sinuate and obsolete before the level of posterior supraorbital pore; microsculpture sharply impressed, mostly consisting of transverse meshes in anterior part and on neck, but largely of transverse lines in posterior part before neck constriction; genae feebly arcuate in dorsal view; antennae extremely long and very thin, extending beyond the apices of elytra at least by two apical segments and the apical half of the 9th, scape the shortest though thickest, fully 1.5 times as wide as segment 2 and nearly 3 times as wide as terminal segment, segments 2–10 each cylindrical except for gentle apical dilatation, segment 2 nearly 1.5 times as long as scape and equal in length to

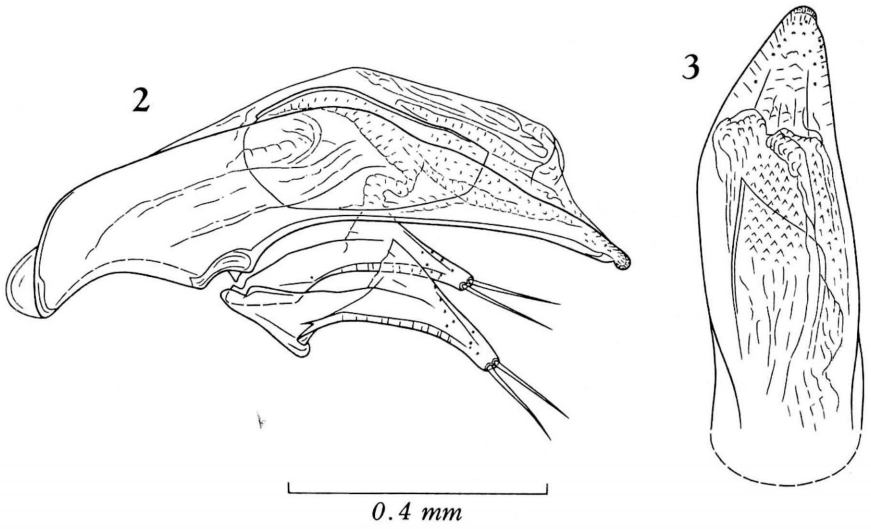
segment 8, segment 4 the longest and about 16.5 times as long as median width, segments 5–9 gradually decreasing in length towards apex, segment 9 about 11 times as long as median width, segment 10 a little longer than scape but slightly shorter than terminal segment, which is nearly 10 times as long as wide; relative lengths of antennal segments from base to apex as follows: 1.00, 1.43, 1.57, 2.29, 2.19, 1.95, 1.64, 1.43, 1.30, 1.12, 1.20.

Prothorax elongate with prolonged apical part, wider than head, much longer than wide, widest at about basal two-fifths, and more gradually narrowed towards apex than towards base; PW/HW 1.36–1.38, PL/PW 1.40–1.43; pronotum narrow though still wider than head, PNW/HW 1.17–1.21, PL/PNW 1.57–1.67; all pronotal margins finely and continuously bordered; pronotal sides gently arcuate at the widest part, nearly straight in front and very slightly arcuate near front angles, and without appreciable ante-basal sinuation; apex very narrow and truncated, with front angles narrowly rounded and not produced; base much wider than apex, slightly emarginate on each side; hind angles effaced and widely rounded; PNW/PA ca. 2.30–2.38, PNW/PB ca. 1.38–1.41, PB/PA ca. 1.66–1.68; dorsum longitudinally convex, especially at the anterior part, with rather steep apical declivity; median line deeply impressed in basal two-thirds, though not extending onto basal area; microsculpture distinct, mostly consisting of very transverse meshes, and partially of transverse lines; apical transverse impression very deep and narrow, widened and longitudinally strigose at the median part, and laterally entering into small basal foveae, which are deep and smooth at the bottom; propleura strongly convex, especially at the posterior parts.

Elytra ovate, much wider than prothorax, and much longer than wide, widest at about two-fifths from bases or a little behind that level; EW/PW 2.01–2.14, EL/EW 1.69–1.81; dorsum very strongly convex, higher than a half the width of elytra, and laterally expanded at about middle so as to conceal reflexed side borders from dorsal view; meshes of microsculpture coarse, almost isodiametric or somewhat transverse throughout; basal parts briefly pedunculate, each elytron with a distinct basal foveole near suture; shoulders distinct, very obtusely angulate; prehumeral borders long, oblique, very slightly sinuate, and complete to basal peduncle; sides subparallel from behind shoulders to apical two-fifths, then gently arcuate to the level of the apicalmost pore of the marginal umbilicate series, and narrowly and conjointly rounded at apices, with very slight preapical emargination; setiferous dorsal pores situated at about one-sixth and two-fifths from base respectively, the anterior one lying sightly before the level of the first pore of the marginal series and the posterior one at about the level of the fourth umbilicate pore.

Ventral surface and legs as described under the genus; metatibia only a little shorter than elytra; tarsi slender though not very long, protarsus about three-sevenths as long as protibia, meso- and metatarsi about three-fifths as long as respective tibiae.

Male genital organ very small though moderately sclerotized. Aedeagus a little less than two-ninths as long as elytra, short, depressed, only slightly arcuate, and widely membraneous on dorsum, with large basal part gently curved ventrad; viewed laterally,



Figs. 2–3. Male genitalia of *Sinaphaenops mirabilissimus* S. UÉNO et F. WANG, gen. et sp. nov., from Tian-zhong Dong Cave in Southeast China; left lateral view (2), and apical part of aedeagus, dorso-apical view (3).

apical half gradually narrowed towards apex; viewed dorsally, apical half nearly parallel-sided to the level of apical orifice and ending in a subtriangular apical lobe; apical lobe inclined to the left, slightly curved ventrad, and left ventrally tuberculate at the tip, which is blunt in lateral view, narrowly rounded in dorsal view; basal orifice very large, almost horizontal, and widely emarginate at the sides; sagittal aileron small though moderately sclerotized; ventral margin nearly straight at middle in profile. Copulatory piece very large, about two-fifths as long as aedeagus, irregularly subovate with pointed right dorsal corner, and rather heavily sclerotized along the dorsal margin. Styles short with narrow apical parts, left style much larger than the right, each bearing two short setae at the apex.

Female unknown.

Type series. Holotype ♂ (preserved in glycerine-alcohol) and 2 ♂♂ (dried), 29–I–1991, WANG Fuxing leg. The holotype is preserved in the Chinese Museum of Karst Geology, Institute of Karst Geology, Guilin.

Type locality. Limestone cave called Tian-zhong Dong, at Mao-lan of Libo County, in Guizhou Province, Southeast China.

Notes. The type locality of this remarkable new species, Tian-zhong Dong, is a limestone cave lying at an altitude of 750 m. The cave is of moderate size, with the galleries of about 550 m in total length. The trechine beetle was discovered at a spot about 100 m removed from the entrance. It is a prowler on stalagmitic walls, all the known specimens having been found crawling on moist stalagmites.

要　約

上野俊一・王 福星：中国南東部で発見された極限のアシナガメクラチビゴミムシ.—— 中国大陸には，広大な石灰岩地帯と数えきれないほど多くの洞窟があるが，局地的とはいえかなり綿密な探索が行なわれたにもかかわらず，無眼のチビゴミムシ類が発見されたことはこれまでになかった．ところが，今年の1月末に，貴州省南東部の茂兰にある天钟洞で，頭部（とくに頸部）や前胸部が異常なまでに伸長し，上翅が膨隆して背の高い気室をつくり，触角や肢の極端に細長いメクラチビゴミムシの1種が見つかった．極限まで特殊化の進んだこのチビゴミムシは，疑いの余地もない新属新種で，世界的にみても比べうるものがない．それで，*Sinaphaenops mirabilissimus* という新名を与えて，この論文に記載した．

いちじるしい形態的変化のために，この特異な属の系統関係を決定するのは容易でないが，大顎の構造や膨腹現象をともなう特殊化の傾向からみて，おそらくニュージーランドの洞窟から知られる2属に，遠い類縁をもつものではないかと考えられる．ニュージーランドに北半球起源の昆虫類がかなり多いことはよく知られている事実で，チビゴミムシ類の場合にもイソチビゴミムシの例がある．中国のアシナガメクラチビゴミムシとニュージーランドのものとの関係は，イソチビゴミムシの場合ほど密接ではないが，中国大陸が多くのチビゴミムシ類をはぐくんだ地域のひとつであることを示す証拠になるかもしれない．

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